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A Life Cycle Systems Engineering (LCSE) Approach to Sustainment

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Tendencies

- Typical approach to sustainment is to wait for the emergence of problems
  - Reliability
  - Obsolescence
  - Training
- Not enough funds are available to develop or implement upgrades while mitigating sustainment issues

Insanity – Performing a task the same way repeatedly and expecting a different result

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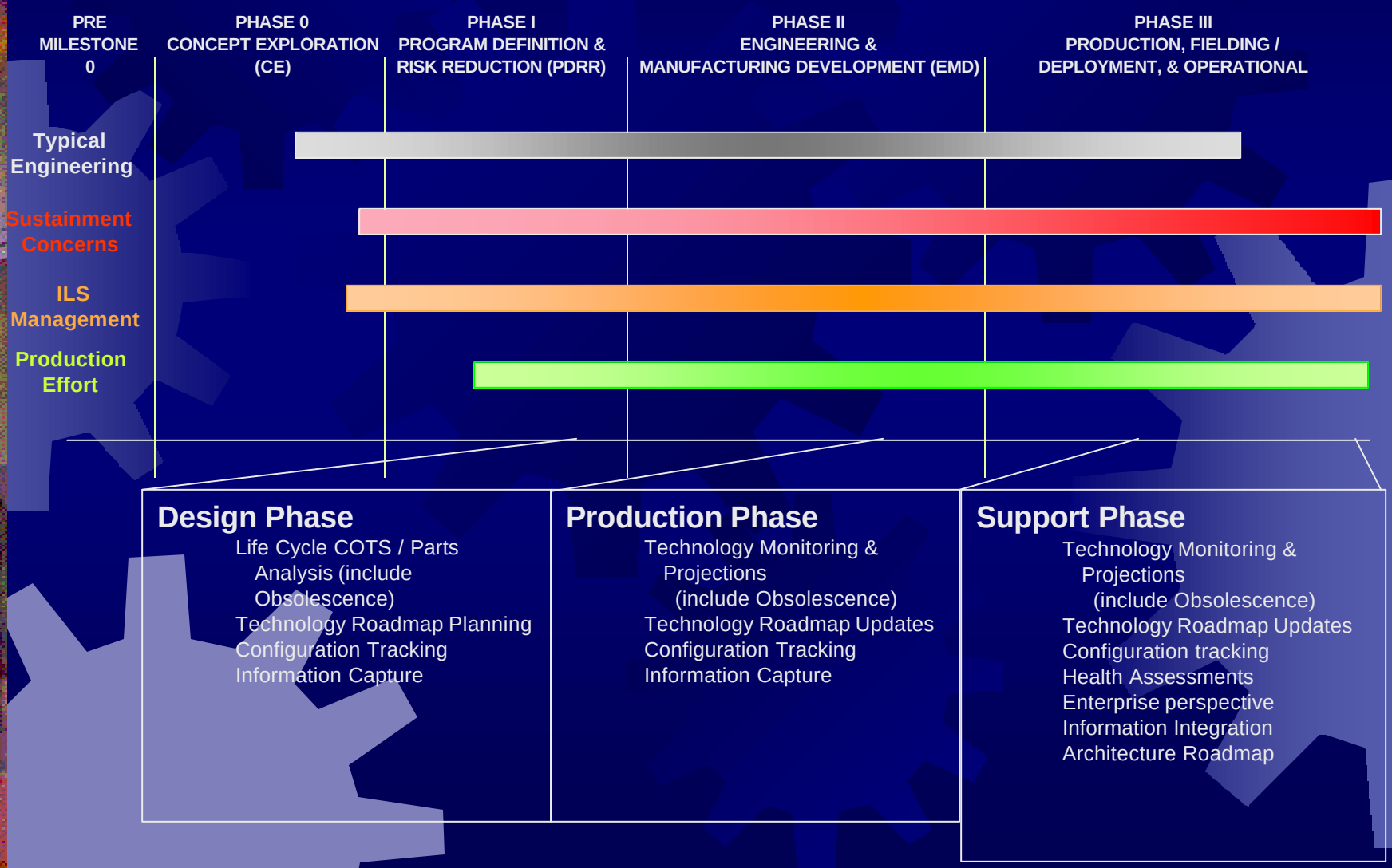
Sustainment Across the Life Cycle



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Life Cycle Systems Engineering (LCSE)

- The process of designing, developing, and maintaining a required operational capability over the desired period of time at an affordable price
- Three basic elements of LCSE:
  - Capture early concept & development requirements
  - Life cycle focus influence designs and component selection
  - Field performance trending (health), repair part availability and forecasting

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Requirements Generation

- Mandatory – Multi-component document
  - CJCSI 3170.01B
- Guideline for conduct of requirements & program reviews at each program milestone
- Life Cycle Requirements Document development
  - Capture sustainment requirements
    - Capstone Requirements Document (CRD)
    - Operational Requirements Document (ORD)
    - Define Key Performance Parameters (KPPs) for sustainment

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Sustainment Attributes

- Typical attributes used include
  - MTBF and A_o
- Potential
  - Modularity
  - Openness
  - Commonality
  - Robustness
  - Redundancy

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Sustainment in the Definition Phase

- Previous attributes are all considered to give 2 new figures of merit for measuring designs
  - Mean Time Between System Upgrades (MTBU)
  - Non-intrusive Upgradeability (NU)

Mean Time Between System Upgrades (MTBU)

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- Considers modularity, commonality and openness
- Applies the expected life cycles of technologies involved
- Creates a figure of merit that varies with changes to system design
- Provides the Program Manager and Logistician with a concrete goal/measure of time between system upgrades

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MTBU

MTBU=$\{(tl_1+tl_2+tl_3\ldots)/n\}*M*C*O$, where

- tl_x is the technology life cycle of a particular technology
- n is the number of technologies
- M is the modularity factor; varies from .5 to 1.5
- C is the commonality factor; varies from .5 to 1.5
- O is the openness factor; varies from .5 to 1.5

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MTBU Uses

- Users specify an MTBU that gives designers their target for years between upgrades
- Designers use the MTBU to measure their design's upgrade life
- Program managers use real & predicted MTBU to plan system life & budget for upgrades

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Non-Intrusive Upgradeability (NU)

- The ability (ease) to incorporate added functionality into a system throughout its life without significant redesign
- Provides a measurement (value)
  - Identify as a sustainment KPP

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NU

NU={(a1+a2+a3…)/n}*R_o*R_e, where

- ax is the architecture number
- n is the number of architectures in the system
- R_o is the robustness
- R_e is the type of redundancy

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Designing in Sustainment

- Early maintenance concept decisions
  - Organics, Commercial, or PBL
  - Levels of Repair / Configuration Control
  - COTS usage versus latest technology
- Periodic sustainment evaluations
  - Component availability & forecasting
  - Supplier depth
- Focus beyond engineering unknown . . . EMD
  - Concentrate on long-term sustainment
  - Mitigate production & support risks beyond contractual requirements

Fielding and Operations Sustainment Support Processes

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- Health Monitoring and Assessment
- Technical Obsolescence Risk Monitoring
- Support Sourcing Depth Management
- Technology Insertion
- Technology Refresh
- Spares Pipeline Management

Anticipate and then rationally respond to change

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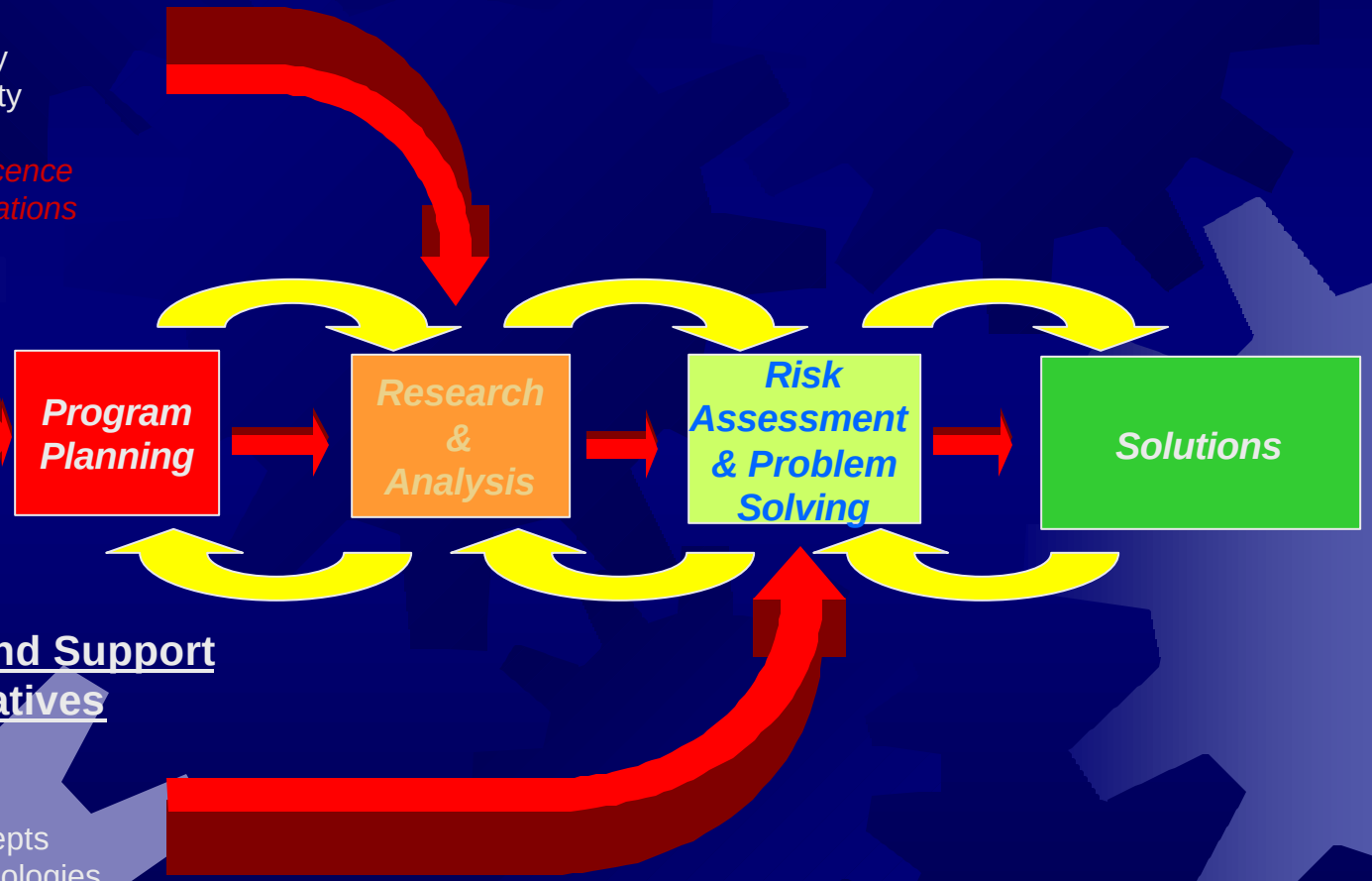
Life Cycle Systems Engineering Process

Fleet and Production Factors

Reliability
Availability
Cost
Obsolescence
Configurations

Programmatic Mandates

Budget
Missions
COTS Mandates
Equipment Plans
Force Projections
Planned Upgrades



Technical and Support Alternatives

COTS
NDI
New Concepts
New Technologies
Software
Proven Solution Sets

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Benefits of LCSE

- ✓ Provides integrated approach to plan for & manage eventual aging of military systems
- ✓ Reduces TOC
- ✓ Is essential in Spiral & Evolution Development
- ✓ Maintains affordable superior combat capability
- ✓ Facilitates planning & executing upgrades when technically feasible & cost-effective
- ✓ Proactively responds to changes in technology within & without a system during its life-cycle
- ✓ Mitigates obsolescence problems caused by shortened technology life cycles of integrated commercial products